

7.2 notes

PROBABILITY RULES!

7.2: Probability

Probability Models- 2 parts:

- * A list of all possible outcomes.
- * The probability of each of those outcomes.

EXAMPLE: M&Ms

Color	Prob.
Brown	30%
Red	20%
Yellow	20%
Green	10%
Orange	10%
Blue	?

Sample Space- All possible outcomes

Examples:

What is the sample space when I roll 2 dice and look at the sum?

2, 3, 4, 5, 6, ..., 12

What is the sample space for the Plinko expt?

0, 100, 300, 400, 500, 200

What about the "Let's make a Deal" experiment?

Win, Lose

Event- An outcome, or set of outcomes.

Ex: When rolling one die, events could be:

Evens, a 5, less than 4, etc.

Probability Notation:

- A, B, C, etc. = **events**. You can also use words. Ex: Hearts

- $P(A)$ = The probability of event A occurring

$$= \frac{\text{\# outcomes in A}}{\text{total possible outcomes}}$$

Example:

$$\begin{aligned} P(\text{Heart}) &= 13/52 \\ &= 1/4 \\ &= 25\% \end{aligned}$$

- S = the Sample Space (all possible outcomes)

- A^c = The **complement** of A

$$\text{Event A NOT happening} = 1 - P(A)$$

Example:

$$\begin{aligned} P(\text{Heart}^c) &= \\ &= 1 - 25\% \\ &= 75\% \end{aligned}$$

Basic Probability Rules

1) $0 \leq P(A) \leq 1$ (100%)

2) $P(S) = 1$ (the sum of the probabilities of all outcomes = 1)

3) $P(A^c) = 1 - P(A)$

4) Basic addition rule:

- * When 2 events have no outcomes in common = **MUTUALLY EXCLUSIVE or DISJOINT**
- * The probability of one event **or** the other event occurring = The sum of their individual probabilities
- * $P(A \text{ or } B) = P(A) + P(B)$

Examples:

What is the probability of getting a spade or a heart?

$$P(\text{Spade or Heart}) = 13/52 + 13/52 = 26/52 = 50\%$$

What is the probability of getting a face card or a 3?

$$P(\text{Face card or 3}) = 12/52 + 4/52 = 16/52 = 30.77\%$$

**note: face card = jack, queen or king

Example 1: If the probability of hitting a homerun is 30%, what's the probability of not hitting a homerun?

$$P(H) =$$

$$P(H^c) =$$

Example 2: If there are only 8 different blood types, fill in the chart below:

Type	A+	A-	B+	B-	AB+	AB-	O+	O-
Probability	0.16	0.14	0.19	0.17	?	0.07	0.1	0.11

Example 1: If the probability of hitting a homerun is 30%, what's the probability of not hitting a homerun?

$$P(H) = 30\% = 0.30 \quad P(H^c) = 0.70 = 70\%$$

Example 2: If there are only 8 different blood types, fill in the chart below:

Type	A+	A-	B+	B-	AB+	AB-	O+	O-
Probability	0.16	0.14	0.19	0.17	0.06	0.07	0.1	0.11

Example 3: Las Vegas Zeke, when asked to predict the ACC basketball Champion, follows the modern practice of giving probabilistic predictions. He says, "UNC's probability of winning is twice Duke's. NC State and UVA each have probability 0.1 of winning, but Duke's probability is three times that. Nobody else has a chance." Has Zeke given a legitimate assignment of probabilities to all the teams in the conference? Why or why not?

Example 3: Las Vegas Zeke, when asked to predict the ACC basketball Champion, follows the modern practice of giving probabilistic predictions. He says, "UNC's probability of winning is twice Duke's. NC State and UVA each have probability 0.1 of winning, but Duke's probability is three times that. Nobody else has a chance." Has Zeke given a legitimate assignment of probabilities to all the teams in the conference? Why or why not?

NO!

His probabilities add up to more than 1 (100%).

$$\begin{aligned} P(\text{UNC}) &= 0.60 \\ P(\text{Duke}) &= 0.30 \\ P(\text{NC St.}) &= 0.10 \\ P(\text{UVA}) &= 0.10 \\ \hline &1.1 \end{aligned}$$

Example 4: Suppose 40% of cars in your area are manufactured in the United States, 30% in Japan, and 10% in Germany.

Probability Model:

Car Origin				
Probability				

If a car is selected at random find the probability that:

- The car is not US made.
- The car is made in Japan or Germany.
- The car is made in the US or Japan.
- The car is neither German nor US.
- The car is not made in US nor Japan nor Germany.

Example 4: Suppose 40% of cars in your area are manufactured in the United States, 30% in Japan, and 10% in Germany.

Probability Model:

Car Origin	US	Japan	Germany	Other
Probability	40%	30%	10%	20%

If a car is selected at random find the probability that:

- The car is not US made. $P(\text{US}^c) = P(\text{not US}) = 60\%$
- The car is made in Japan or Germany. $P(\text{Japan or Germany}) = P(J \text{ or } G) = 40\%$
- The car is made in the US or Japan. $P(\text{US or J}) = 70\%$
- The car is neither German nor US. $P(G^c \text{ and } \text{US}^c) = 50\%$
- The car is not made in US nor Japan nor Germany. $P(\text{US}^c \text{ and } J^c \text{ and } G^c) = 20\% = P(\text{other})$